Required parameters are missing or incorrect.}*Instruction:* *This template should be used for interim and full technical reports.*

Reporting Period

Section A. Partner Information

A.1. Institution: ICRISAT

A.2. Contact person: Dr. Bouba Traore

A.3. Intervention sites, country: Koutiala district , Mali

A.4. Other partners:
IPR/IFRA, IER and AMEDD

Section B. Progress/achievements during the reporting period

Excecutive summary of achievements

Composting activity

The method was based on composting heaps instead of composting pits. Five composting treatments were compared respectivelly with stem of cotton and sorghum. Stem of both crops was cut into pieces of 10 to 20 cm arranged under successive layer, spread of different activators (inoculum, urea, cattle manure and Rock Phosphat) and is irrigated with water. Each compost heap was covered with a plastic bag to limit evaporation and accelerate decomposition.

Results indicated that compost 4 consisting of 1 ton of cotton stems + 25 kg / ha of PNT has the lowest C/N ratio (10.6) while the highest C/N ratio (19.5) was obtained with 1 ton of sorghum stalks + 25 kg of PNT + 25 kg of urea + 1 kg of inoculum compost plus.

For on farm field, the experimental design was Fisher Block with two replications with maize as testing crop. Compost produced under composting activity was tested under 6 mains treatments based on different hill placement of compost from 1 to 5 tonnes. Treatments were compared to the control and farmer compost application practice. Experiment was implemented with 7 farmers from Mpessoba district.

Results showed that yield of maize obtained with 2.5t/ha of organic manure by local application is statistically equal to those obtained with 5t/ha of organic manure by using farmer spreading method. Thus, from these results, we infer that use of the organic manure at the rate of 2.5 t/ha by localized application helps farmer to save about 50% of organic manure compared to conventional method and therefore can be used for other field.

Survey on soil fertility management strategy

For understanding soil fertility management strategy information was collected through survey on field status, soil type, crop type, previous crop, crop residues collection, crop yield, manure application etc. Livestock information was collected on herd structure, other livestock numbers, guarding mode and residues storage for fodder.

Results show that 52.78% of the organic manure produced comes from the night animal housing system against 21% and 15% respectively for garbage and composts. For type C farms, organic fertilizer comes mainly from household waste and composting. Main constraints for accessing to organique manure are related to the lack of means of transport and labour.

B.1. Achievements (progress and/or results) against outputs towards outcome 1

Project Outcome 1: Outcome 1: Farmers and farming communities in the project area are practicing more productive, resilient, and profitable and sustainably intensified crop-livestock systems linked to markets.				
Output 1.1: Research products for more productive, intensive, diverse, profitable and resilient crop (cereals, legumes, and vegetables); livestock (sheep, goats, cattle, poultry and pigs) and integrated crop-livestock farming systems are identified and disseminated to farmers through development partners in the intervention communities.	Planned Activities Activity 1.1.1: Test a combination of climate-smart crop varieties and agronomic practices to increase and sustain food and feed production Sub-activity MA1113-17: Improving efficiency of compost processing for soil fertility management under cereal cropping system	Planned Milestones 1. Constraints and opportunities for organic fertilizer production are identified. 2. Promising composting technology is being developed 3. Efficiency of application technique of compost is demonstrated	Deviation from Planned Milestone 1. One MSc student instead of 2 2. None 3. None 4. None	Achievements towards Output - data collection on composting , - data collection crop production under different manure application on field - Recording collected data

Tableau 1 : Types of organic manure produced by producers

Farm type	Household waste	Compost	Compost and Crumb park	Household waste and Cattle manure	Compost and cattle manure	Night stabulation
A	2,50	12,50	0,00	0,00	0,00	75,00
B	13,33	0,00	6,67	6,67	6,67	66,67
C	50,00	33,33	0,00	0,00	0,00	16,67
Mean (%)	21,11	15,28	2,22	2,22	5,00	52,78

Tableau 2 : Effect of technology on yields of treatments

	Spike width (cm)	Spike lenght (cm)	Yield (Kg/ha)	
			Grain	Straw
T1	3,450 a	13,5 a	1177 a	2083 a
T2	3,900 b	14,02 b	1443 a	2469 b
T3	4,320 b	14,43 b	1851 b	2786 b
T4	4,130 b	14,08 b	1765 b	2615 b
Mean	4	14	1557,3	2083,3
F prob.	0,001	0,002	0,0001	0,0001

Tables and graphs in support of achievements

Photo 1 : Preparing material (stem) **Photo 2 :** Preparing heap site

Photo 3 : Composting heap formation

Photo 4 : Covering composting heap **Photo 5** : Spreading of water

Figure 1: Step of composting

In the study area average farm size is 11.29 ha but varied according to farm typology. Farm type A and B holdings average of 16 ha and 10 ha respectively, compared to 7 ha for farm type C. Two third of cropping area is devoted to 2/3 cereal crops with largest size for millet (3.26 ha) against 2.93 ha and 2.50 ha respectively for sorghum and and sorghum. Average population per farm is 20 persons, with respectively 34 and 17 people for farm type A and B against 10 people for farm type C. Farm workforce depends on population size. Thus farm types A and B have respectively 12 and 7 workforce versus 4 for type C farms. Overall, 3 are involved in parallel activities such as trade or gathering, or poultry farming for at least 4 months per year.

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For organic matter manure production, our servey shows that 52.78% of the organic manure comes from night animal stabulation compared to 21% and 15% respectively for household wast and composting (Table 1). Most of the manure for farm type A and B principally produced from the night animal stabulation with proportions corresponding to 75% and 66.67%, respectively while for farm type C, organic matter comes mainly from household waste and composting. Over all 46% of farm's organic matter is manufactured by combined efforts of women, young man and children. Young man alone produces 21% farm organic manure.

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Main constraints related to the use of organic manure are mainly the lack of means of transport and labor representing 45.83% for farm type A, compared to 33.33% for farm type B and C. In addition, for some farms composting activity overloads working schedule. Principale constraints for composting are due to lack of water, equipment, labor and lack of animals. In addition to these, correlation shows significant relation ($P < 0.05$) between organic manure produced per ha and variables such as number of active persons, total cropping area (ha) and number of cattles.

Analysis, interpretation and discussion of achievements

Statistical analyzes show significant differences (P <0.0001) between treatments (Table 2) for respectivelly for grain and straw yield. Highest grain yield is obtained with treatment T3 (1851 Kg) and T4 (1765 Kg) while lowest grain yield is obtained with treatment T1 and T2 treatments. Highest straw yield is obtained resepctivelly with treatments T3 (2786 Kg), T4 (2615) and T2 (2469 Kg) while lowest yield was obtained with treatment T4 (2083 Kg).

For manure management our study shows that management of organic matter is a complex process and varies fundamentally according to the characteristics of each farm type. For example, a farm with more assets or livestock, especially cattle, has more opportunities to produce enough manure for fertilizing crops, unlike farm type C, which has fewer assets and fewer resources. However, despite this "large quantity" of manure produced by large farms, several studies carried out in the study area (Sanogo 2002); Kanté, 2001) show that these quantities covers only 26% of the total area and remains insufficient to meet the needs of soil organic matter. Discussions with farmer highlighted crucial role played by the lack of labor in the organic manure production process. Our results indicated for all farms type 25% to 50% of the assets perform other non-agricultural activities especially during post-harvest periods corresponding to the periods adapted for organic manure production. Due to transportation constraints farmer applicate organic manure to nearest field to household thus improving soil fertility compare to the extended field.

In addition to animal park manure especially for large and medium-sized farms, our results have shown that composting is mainly practiced by small farms that do not have sufficient technical and financial resources and because of availability of in-kind resources such as biomass, water or labor. Mastering composting procedure combining with biomass selection, equipment, application of biostimulant or water uses at time scale. However, constraints related to pits construction require physical efforts that tend to discourage most producers. The aerobic method tested in this study offers advantage of eliminating the constraint related to the digging of pits as well as biomass decomposition through the decrease in the volume of the heaps which varied according to the treatments applied. This decomposition is facilitated by increasing of temperature from 30 ° C to 47 ° C indicating high intensity of microorganisms activity as well as dynamics of microbial

populations leading to color changes. Temperature stabilizing at 30 °C observed at 87th day of composting, indicates the cessation of microorganisms activities (Lompo et al., 2009).

Total amount of water needed for composting one ton of cotton stems was 7970 liters, which is close to that obtained by (Ouattara, 2016). For some farmers this quantity seems to be a major constraint because of the rapid dewatering wells in connection with the low groundwater supply. However, it is important to note that this water supply is done in a staggered way, thus leaving time for reloading well water.

Application method of organic matter

In contrast to use of chemical fertilization by microdosing (Sawadogo et al., 2009), there is only few reports on microdosing of organic fertilization, although it is largely applied by producers under the Zaï system (Zougmoré et al. , 2014). Our results showed that with application of organic matter by microdosing at 2.5t.ha-1 method maize yields are statistically similar to those obtained with 5t .ha-1 under farmer's practice. These results demonstrate interest of localized application of organic fertilizer to the extent that in equal quantities, with spreading method, it saves 50% of organic manure per hectare. This approach favors proper development of crop through concentrating sufficient amount of organic matter around rooting system. To some extent microdosing technique limits spreading of wed seeds and thus facilitates weed control and limits competition with principal crop. Recent studies by Aune et al., 2017 attribute to the approach the label of "precision agriculture" for the Sahelian zone.

Highlight SI indicators and their defining metrics

For this study, the SI indicators and the metrics are below.

<u>Productivity:</u> Yield, Biomass, Farmer perception, Agricultural survey at farm scale

<u>Environmental:</u> Soil sample was collected ad analyzed

<u>Economic:</u> Profitability, diversification of technology at household level

<u>Social:</u> Farmer perceptions, Access to production factors,

<u>Human:</u> Two new practices were tested plot level

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Kindly puf figures under each domain and send me back

B.2. Achievements (progress and/or results) against outputs towards outcome 2

Project Outcome 2: More farmers and farm families are adopting technologies and practices to improve nutrition, food and feed safety, post-harvest handling and value addition.				
Output 2.1: Improved technologies, innovations, practices and habits to increase production and consumption of safe diverse and more nutritious food for farm families, especially by women and children, developed and disseminated in partnership with research and development partners in intervention areas in Northern Ghana and Southern Mali.	Planned Activities 1. 2. 3.	Planned Milestones 1. 2. 3.	Deviation from Planned Milestones	Achievements towards Output
Output 2.2: Postharvest technologies and practices to provide options for the food, and feed sectors are tested and	Planned Activities	Planned Milestones	Deviation from Planned Milestones	Achievements towards Output

disseminated to farmers through researchers, extension staff, development partners.				

Tables and graphs in support of achievements

Analysis, interpretation and discussion of achievements

Highlight SI indicators and their defining metrics

B.3. Achievements (progress and/or results) against outputs towards outcome 3

Project Outcome 3: Farmers and other value chain actors have greater and equitable access to production assets and markets (input and output) through enabling institutions and policies.				
Output 3.1: Enabling policies and institutional arrangements to increase participation of farm families, especially women and youth in the output and input markets and decision-making are advocated for implementation by national governments, policy makers and development partners.	Planned Activities 1. 2. 3.	Planned Milestones 1. 2. 3.	Deviation from Planned Milestones	Achievements towards Output
Output 3.2: Options to expand accessibility of production assets and increase participation in household decision-making by disaggregated groups by gender and age.	Planned Activities 1. 2. 3.	Planned Milestones	Deviation from Planned Milestones	Achievements towards Output

Tables and graphs in support of achievements

Analysis, interpretation and discussion of achievements

Highlight SI indicators and their defining metrics

B.4. Achievements (progress and/or results) against outputs towards outcome 4

Project Outcome 4: Effective partnerships are built with farmers, local communities, and research and development partners in the private and public sectors to ensure delivery and uptake at scale of SI technologies, innovations and practices.				
Output 4.1: Alliances and effective partnerships developed between farmers, local communities, and research and development agents in the public and private sectors to enable the release, dissemination, and adoption of proven technologies and practices at scale.	Planned Activities 1. 2. 3.	Planned Milestones 1. 2. 3.	Deviation from Planned Milestones	Achievements towards Output
Output 4.2: Gender-sensitive decision support tools to assess technology-associated risks and opportunities are available for use by project partners.	Planned Activities 1. 2.	Planned Milestones	Deviation from Planned Milestones	Achievements towards Output
Output 4.3: An updated framework for monitoring technology adoption to be used by the project team and scaling partners available and accessible.	Planned Activities 1. 2.	Planned Milestones	Deviation from Planned Milestones	Achievements towards Output
Ouput 4.4: Knowledge sharing centers (physical structures) and learning alliances are developed within existing local and regional institutions.	Planned Activities 1. 2.	Planned Milestones	Deviation from Planned Milestones	Achievements towards Output

Tables and graphs in support of achievements

Analysis, interpretation and discussion of achievements

Highlight SI indicators and their defining metric

B.6. Synthesis

Use the SI indicator results to illustrate how outputs under the 4 outcomes are defining your innovation/technology.

B.7. Capacity Building

Tabulate: Type/title of training, where, when, number and category of people trained

01 MSc Student

Coulibaly Sery (2017) Stratégies d'amélioration de la production et de l'utilisation de la Fumure organique pour une gestion durable de la fertilité des sols au Mali-sud. IPR/IFRA de Katibougou, Mémoire d'ingénieur Agronome.

When: from April 1st to Decemeber 31 2017

Trainng of farmer: 40 farmers were trained on composting activities

Section C. Problems/challenges and measures taken

Main challenge faced for implementing this study was delay of approval and funding uncertainty for recruitment of new students. As implication we have cancelled MSc and PhD student recruitment which was formelrly planned.

Section D. Partnership/linkages with other projects

Section E. Lessons learned

Section F. Monitoring and Evaluation

F.1. Feed the Future indicators

Tabulation with the following columns: (i) FtF indicator, (ii) Annual target (iii) Progress toward target, (iv) Segregation, (v) explanation for over/under achievement (only for full report)

Info must also be provided to the Africa RISING Economist and/or to the project M&E specialist when needed for reporting to USAID FTFMS (usually during October each year) using PMMT.

F.2. Custom indicators

Tabulate (i) Custom indicator, (ii) Annual target, (iii) Progress toward target, (iii) explanation for over/under achievement

Section G. Success stories